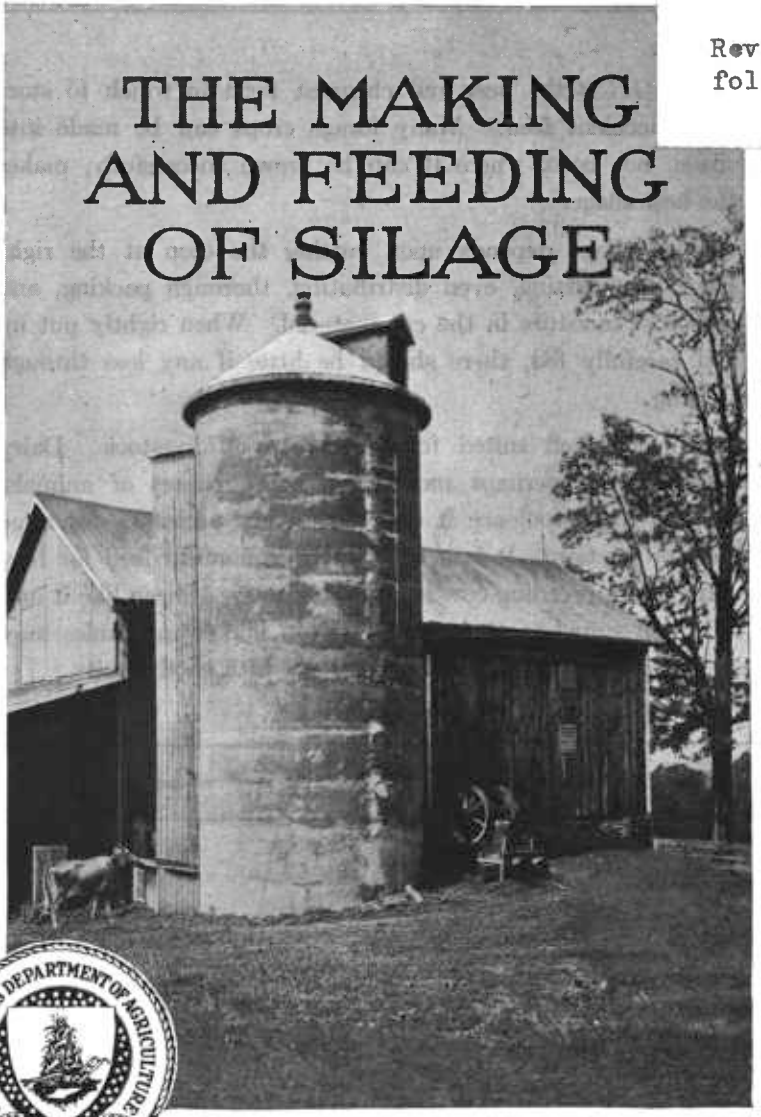
U. S. DEPARTMENT OF AGRICULTURE

FARMERS' BULLETIN No. 578

rev. Nov 1923

Rev.ed. follows

THE MAKING AND FEEDING OF SILAGE



SILAGE is the best and cheapest form in which to store succulent feed. Many forage crops can be made into silage, but corn, where it can be grown successfully, makes the best silage.

Good silage depends upon cutting the crop at the right stage, fine cutting, even distribution, thorough packing, and plenty of moisture in the cut material. When rightly put up and carefully fed, there should be little if any loss through spoiling.

Silage is well suited for feeding to all livestock. Dairy cows need it perhaps more than other classes of animals, because the succulence it supplies is very necessary for large milk production. It is a cheap and economical feed for beef cattle, from breeding cow to fattening steer. Sheep like it and it is well suited to their needs. Even horses and mules may be fed limited quantities of good silage with good results.

Washington, D. C. Issued July, 1918; revised November, 1923

THE MAKING AND FEEDING OF SILAGE.

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CONTENTS.

SILAGE, ITS PREPARATION AND FEEDING VALUE.

T. E. WOODWARD and J. B. MCNULTY, *of the Dairy Division*.

SILAGE is any fodder or grass that has been cut and packed in an air-tight container or pit, with moisture enough to allow a partial fermentation, which preserves it in a slightly sour condition. Dairymen and feeders of cattle have long appreciated the value for milk and meat production of the succulent pasture grasses which are so abundant in the spring and summer. To obtain succulence in the winter, or when pasture is not available, forage crops are made into silage.

Silage has certain laxative properties which keep the digestive organs of animals in good condition. Live stock receiving some form of succulent feed have keener appetites, softer and more pliable skins, and a more thrifty, healthy appearance than those fed exclusively on dry rations.

CROPS SUITABLE FOR SILAGE.

Almost any green crop can be made into silage successfully. Considerable care must be taken, however, to expel the air from such hollow-stemmed plants as the small cereal grains by cutting fine and packing firmly. Other crops, of which legumes are examples, are deficient in the fermentable constituents needed for palatable silage. On the other hand, a few crops, such as the saccharine sorghums, have so much sugar that unless cut at a more mature stage they have a tendency to produce sour silage.

[1] Mr. McNulty resigned from the department August 26, 1919, and Mr. Rommel October 31, 1921.

CORN.

Corn is the common silage crop wherever it can be grown successfully. Silage made from it contains a high percentage of digestible nutrients, has a good flavor, is very palatable, and will keep in good condition for years. When it is properly siloed the losses of digestible nutrients from fermentation are smaller than in most other crops.

In most parts of the United States more food material can be obtained from an acre of corn as silage than from an acre of any other crop that can be grown. Corn is more easily harvested and put into the silo than crops like rye, clover, cowpeas, or alfalfa, and when cut for silage the maximum quantity of nutrients is preserved. Experiments have shown that corn, when siloed, lost 15.6 per cent of the dry matter, against 23.8 per cent when cut for fodder and cured in the field.[1] Moreover, there is less waste in feeding silage than in feeding fodder, since good silage properly fed is all consumed. When corn is cut for silage the land is cleared and left ready for another crop sooner than when the corn is shocked or is husked from the standing stalk. Corn can be put into the silo at a cost not above that of shocking, husking, grinding, and shredding.

In spite, however, of the many strong points in favor of corn as a silage crop, it is not a perfect ration, because it is low in both protein and mineral matter. Sometimes, in filling the silo, clover, cowpeas, or alfalfa is mixed with corn in order to correct the deficiency of protein. This is not to be advised if legumes can be harvested successfully for hay. Since live stock need dry roughage, it is usually most satisfactory to feed legumes, such as clover and alfalfa, as hays rather than to mix them with the corn when filling the silo.

VARIETIES TO PLANT.

Since there is a steady increase in all nutrients of a corn crop up to maturity, it is best to plant a variety of corn that will mature sufficiently for silage before frost. In any locality the variety commonly raised for grain is ordinarily the most satisfactory for silage, as the grain contains more nutriment than all the rest of the plant. In certain localities where there is a scarcity of succulence or roughage it is often advisable to plant a variety that yields a larger proportion of stalks and less grain than most northern corn.

In Table 1 (from the First Annual Report of the Pennsylvania State College) it may be noted that 63 per cent of the digestible food materials present in the corn plant are found in the ears and 37 per cent in the stover.

[1] A Book on Silage, F. W. Woll ,1900.

TABLE 1.—*Yield per acre of digestible matter in corn.*

Constituents.	Yield per acre.		
	Ears.	Stover.	Total crop.
	Pounds.	*Pounds.*	*Pounds.*
Protein	244	83	327
Carbohydrates	2,301	1,473	3,774
Fat	125	22	147
Total	2,670	1,578	4,248

FIG. 1.—A fine crop of corn for silage.

METHODS OF PLANTING.

Corn for silage is often planted more thickly than for grain, a very common practice being to plant it 6 or 8 inches apart in rows from 3 feet 4 inches to 3 feet 8 inches apart. This method of planting, however, allows cultivation in one direction only, and is not recommended for weedy land. If serious trouble with weeds is expected

the corn should be planted in hills so that it can be cultivated both ways. When there is sufficient rainfall thick planting yields as a rule more per acre, but the silage does not contain so high a percentage of digestible nutrients as in thin planting. At the Dairy Division farm, Beltsville, Md., it was found that corn planted at the rate of 4 stalks to the hill yielded a somewhat greater tonnage but very little more digestible food material than at the rate of 2 stalks to the hill. In all cases the fertility of the land influences, to some extent at least, the rate of planting. Thick planting is usually more successful on rich soil than on poor soil.

YIELD.

From 4 to 20 tons of silage can be obtained from an acre of corn. A 50-bushel crop of corn yields from 8 to 12 tons of silage per acre, depending upon the amount of leaves and stalks that accompany the ears and upon the stage of maturity at which it is siloed.

The quantity of silage that may be expected per acre is often roughly estimated at 1 ton for each 5 bushels of shelled corn. Southern varieties of corn as a rule have a larger proportion of stalks and leaves than northern-grown varieties.

TIME TO HARVEST.

Ordinarily corn should be harvested for the silo about a week or 10 days before it would be cut for shocking; that is, when about 90 per cent of the kernels are dented and at least 75 per cent of the kernels are hardened so that no milk can be squeezed out. At this time the lower leaves on the stalk are turning brown and the green corn fodder contains 65 or 70 per cent of moisture, which is sufficient for silage. Silage made from corn containing moisture enough for proper preservation is more palatable than that made from corn so mature as to require the addition of water.

Table 2 (taken from the Eighth Annual Report of the New York State Agricultural Experiment Station) shows the steady increase in the yield of food nutrients per acre up to the time the corn is ripe. For this reason the corn plant should be allowed to mature as much as possible and still have moisture enough to pack the corn properly in the silo without the addition of water. Probably the moisture content should not fall below 65 per cent or exceed 75 per cent. Of course, where a large quantity of silage is made and the operation lasts for weeks the moisture content can not be kept within those limits.

TABLE 2.—*Chemical changes during growth of corn plant.*

Yield per acre.	Stage of growth.				
	Tasseled, July 30.	Silked, Aug. 9.	Milk, Aug. 21.	Glazed, Sept. 7.	Ripe, Sept. 23.
Total yield	*Pounds.* 18,045.00	*Pounds.* 25,745.00	*Pounds.* 32,600.00	*Pounds.* 32,295.00	*Pounds.* 28,460.00
Water	16,426 00	22,666 00	27,957.00	25,093.00	20,542.00
Dry matter	1,619.00	3,078.00	4,643.00	7,202.00	7,918.00
Ash	138 91	201 30	232.15	302.48	364.23
Albuminoids	239.77	436 76	478.69	643.86	677.78
Crude fiber	514 19	872 93	1,261.97	1,755.85	1,734.04
Nitrogen-free extract	653 91	1,399 26	2,441.29	4,239.82	4,827.60
Fat	72.20	167.75	228.90	259.99	314.34

IMMATURE AND FROSTED CORN.

When weather conditions such as hail, drought, or frost prevent the maturing of corn for the silo, it may be cut while still immature and produce a fair grade of silage. A good practice is to mix the corn with some which is more mature. Silage from immature corn will be sourer than usual and more laxative when fed in large quantities, a trouble that can be avoided by care in feeding.

Frosted corn dries out very quickly and many leaves are lost in handling. The corn may be so dry, also, that it will not pack well, which necessitates the addition of considerable water at the time of filling. Frosted corn should be cut as soon as possible in order to prevent excessive drying out. If this is done the stalks may contain sufficient moisture for satisfactory silage without adding water. The frosting of the corn causes only a small loss in feeding value, the greatest loss being due to the loss of leaves in handling and the possible spoiling of part of the silage owing to its failure to pack and keep properly.

DRY CORN FODDER.

Sometimes there is a delay in filling the silo, and it is necessary to cut and shock the corn. On farms which have a limited silo capacity, it is often desired to refill the silos after the silage has been fed out.

Dry corn fodder may be siloed successfully, but it is absolutely necessary that a sufficient quantity of water be added to wet it enough so that it will pack well in the silo. Water may be added by allowing a stream from a hose to flow into the blower while filling. In addition it is desirable to sprinkle the surface of the cut material as it is distributed in the silo. Corn-fodder silage is not so palatable nor so good as silage made when the corn is at the proper stage. The Missouri station reports that the water to be added should be of the same weight as the corn fodder.[1] . Owing to the large quantity of water required, siloing corn fodder is advisable only on farms having a water system.

[1] Circular No. 71, Missouri Agricultural Experiment Station

SORGHUMS.

Saccharine sorghums, such as amber cane and orange cane, and nonsaccharine sorghums, such as kafir, feterita, milo, and Sudan grass, are all suitable for silage. On account of their greater resistance to drought, sorghums are more dependable and yield more in those regions of the South and West where the rainfall is too light or irregular for a good growth of corn. For successful silage it is important that they be harvested when the seed has become hard.

FIG. 2.—Shock corn, if properly handled, will make fair silage.

If harvested earlier, a silage with a high acid content is produced. Experiments in Kansas [1] and California [2] indicate that there is little difference in feeding value between sorghum and corn silage. A mixture of corn and sorghum has proved to be satisfactory in some localities where the rainfall is so variable as to make the corn crop uncertain.

LEGUMES.

The legumes include the clovers, sweet clover, alfalfa, cowpea, soy beans, velvet beans, and the vetches. All such forage crops, if prop-

[1] Circular 28, Kansas Agricultural Experiment Station.
[2] Bulletin 282, California Agricultural Experiment Station.

erly handled, yield a fairly high grade of silage. Whenever possible it is a much better plan to cut and cure legumes for hays, for while high in protein and mineral matter they are low in sugars, which produce the desirable fermentation characteristic of corn silage. It is probable that the small quantity of sugar in legumes is responsible for the lower palatability and shorter keeping qualities of legume silage as compared with silage made from corn or the sorghums. It has been reported [1] that when ordinary blackstrap molasses was added to alfalfa silage at the rate of 1 part to 20 by weight there was a very marked improvement in the flavor, palatability, and keeping qualities of the silage. Most legumes should be cut for silage at the same time as for hay.

There is a tendency in all feeds, when put into a silo, for the food nutrients to decrease slightly. This is due, in part at least, to the losses from fermentation. Legumes in particular suffer a decided loss in nutrients. Legume silage does not pack so well as corn silage, and for this reason it should be cut very fine and firmly tramped. A shallow silo is especially unsatisfactory. Corn or sorghum when mixed with legumes improves both the flavor and the keeping qualities of the silage.

Cowpeas and soy beans may be siloed separately, but generally they are used in combination with corn or sorghum. They are grown either in separate fields or with the corn. Cowpeas when grown with corn climb the stalks and make harvesting difficult. Soy beans being self-supporting can be harvested readily with the corn by means of a corn binder. For this reason and because they can be planted earlier in the season, soy beans make a more satisfactory crop to grow with the corn. Some authorities assert that soy beans grown with corn do not lower the yield of corn, but an experiment on the Dairy Division farm at Beltsville, Md., indicates otherwise. Probably the most desirable plan is to grow the legumes in separate fields, and mix them with the corn at silo-filling time.

A strong odor is imparted to milk if legume silage is fed to cows immediately before they are milked or if milk is exposed to the odors of the feed. It is therefore advisable to feed legume silage either immediately after milking or several hours before.

SMALL GRAINS.

When small grains, such as wheat, barley, buckwheat, rye, and oats, are used for silage they should be cut when the kernel is just passing from the milk into the dough stage. It is very important to cut them fine and pack them firmly in the silo.

The small grains ordinarily make more palatable silage than the legumes, but are inferior to either corn or sorghum. Because of the

[1] O. E. Reed in Hoard's Dairyman, Mar. 16, 1917.

early stage at which they must be cut and the normal loss from fermentation, there is a marked loss in digestible nutrients in silage made from small grains as compared to maturing them for grain. It is usually advisable, therefore, to harvest them for grain. Only when corn or sorghum can not be grown successfully and the need of succulent feed is great is it desirable to cut small grains for silage.

The same precautions to avoid giving milk an objectionable flavor, as mentioned for legume silage, are necessary with silage made from small grains. Rye silage is especially liable to affect the flavor of milk.

FIELD PEAS AND OATS.

Peas and oats planted together make a palatable silage high in protein, and are particularly adapted to sections of the United States where the climate makes the growing of corn or sorghum uncertain or impossible. The best time to cut this crop for silage is when the oats begin to pass from the milk into the dough stage, and when the pea pods have fair-sized peas in them. Seldom, however, can both crops be siloed at the proper stage. Peas that are planted from 7 to 10 days earlier than the oats usually reach the right stage for siloing at the same time as the latter. Fine cutting and hard tramping are necessary when peas and oats are siloed together.

MILLET.

The millets are not generally used as silage crops, although those who have had experience with them say that a fair grade of silage can be made if the crop is cut when nearly ripe enough for seed. It should be cut fine and packed firmly in the silo. As a rule, however, the millets are more profitable when used as soiling crops or as hays.

PEA VINES.

Pea vines from canning factories are used extensively for silage. In feeding value they are about equal to corn silage, being a little richer in protein, but containing about the same quantity of total digestible nutrients. Frequently pea vines are stacked instead of being put into the silo, in which case considerable loss occurs, especially if the stack is opened in warm weather. Stacked pea vines should not be opened until cold weather or until such time as the silage can be fed continuously. Pea-vine silage is rather laxative and should always be fed with care. Because of its strong odor it should always be fed after milking.

BEET TOPS.

If properly handled, beet tops and crowns can be made into good silage. The tops should be run through the cutter and put into the silo promptly after the beets are topped. In gathering the tops from the field care should be taken to have them free from dirt, as it

damages the silage. Cut straw should be placed in the bottom of the silo to absorb the excess moisture, and as fast as the tops are cut straw should be mixed with them. In filling the silo special care should be used to have the edges packed firmly. Salt sprinkled over the contents every few inches increases the palatability of the silage. After filling, a 12-inch layer of cut straw should be placed on the top to make the silo as nearly air-tight as possible. Other coarse roughages, such as corn or cane stover, can be used in place of the straw. Water should not be added to the silage.

RAPE.

If harvested when nearly mature but still succulent, rape makes a silage of fair quality. It can be put in the silo with mature corn or sorghum, legumes, or straw, and thus produce a good grade of silage. A mixture of rape and alfalfa, clover, or sweet clover makes the best silage, being somewhat better than legumes alone, as the rape contains sugars which are lacking in legumes.

CANE TOPS AND CANE BAGASSE.

Tops from sugar cane have been made successfully into silage. The cane tops and leaves should be run through a cutter before they are placed in the silo. Such silage, although not so good as corn silage, can well be used in those sections where sugar cane is grown abundantly, thus utilizing what otherwise would be wasted. Cane bagasse or pomace also makes a fair quality of silage.

SUNFLOWERS.

Sunflowers are coming into more general use on the irrigated lands of the West and Northwest, where the weather is too cool and the season too short for the best growth of corn. There seems to be a universal agreement among investigators that sunflowers will yield a much greater tonnage than corn. As high as 29.75 tons to the acre have been reported by the experiment station at Huntley, Mont. At that station it was likewise found that when planted in rows 20 inches apart the sunflowers gave greater yields than when planted farther apart. The plants were about 10 inches apart in the rows, and 15 pounds of seed were used to the acre. Unless harvested soon after they come into bloom and before the seeds are developed, the silage will be unpalatable. Sunflowers are not so easily handled as corn, on account of their stiff, brittle stalks, and because the heads tend to clog the feeding rolls of the silage cutter.

MISCELLANEOUS CROPS.

Beet pulp, apple pomace, Russian thistles, and corn husks from canning factories are also occasionally used for silage, but in general are not so satisfactory as other crops.

HARVESTING THE CROP AND FILLING THE SILO.

Corn or sorghums for the silo may be cut by hand, with the sled cutter, or with the corn harvester. Hand cutting is practiced on farms where the quantity to be harvested is so small as to make the expense of purchasing a corn harvester too great to justify its use. Under such circumstances, however, two or three farmers may purchase a corn harvester together. Very frequently corn is down or in such position as to make it impossible to cut with either the sled or the corn binder, in which case hand cutting is necessary. Of the three methods, the cost per acre of cutting corn was found to be

FIG. 3.—A corn harvester at work.

lowest when the sled cutter was used.[1] All things considered, however, the corn harvester is a more satisfactory method of cutting corn for the silo.

In using the corn harvester the bundles should be made rather small. While this takes more twine the extra expense is more than offset by the ease of handling the bundles and in feeding them into the silage cutter. Two to four horses and one man will be required to run the harvester, which should cut about 6 acres a day. The harvester should not get so far ahead of the haulers that the corn will lose any considerable moisture before it is hauled to the cutter.

HAULING TO THE CUTTER.

The corn ordinarily is hauled to the cutter with the common flat hay frames. An objection to their use is the hard work necessary

[1] See Bulletin 145, Nebraska Agricultural Experiment Station.

to lift the green corn fodder so high in loading. A low-wheeled wagon is much preferable to a high-wheeled one. A low hayrack very commonly used in some parts of the United States can easily be made. The following directions for making a rack of that kind are taken from Farmers' Bulletin 292, "Cost of Filling Silos":

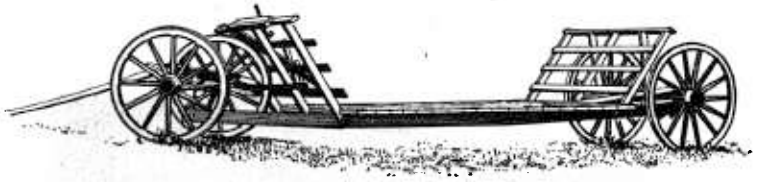

FIG. 4.—A low rack suitable for hauling corn to cutter.

The rack consists of two 4 by 6 inch bed pieces, 18 or 20 feet in length, bolted together at the end to form a V. On top of these timbers is built a rack 6 feet in width. The bottom of this rack is about 8 feet long. The end boards are 4 feet high, built flaring so they do not quite touch the wheels. The apex of the V is suspended below the front axle of an ordinary farm wagon by means of a long kingbolt. The other ends are attached below the hind axle by U-shaped clevises. The materials needed in its construction are 80 board feet of 4 by 6 inch plank, 96 feet of boards 1 by 12 inches, 22 feet of lumber 2 by 4 inches, 1 long kingbolt, 2 stirrup rods, and bolts and nails.

FIG. 5.—Hauling corn to the silage cutter.

If few teams are available and the haul is long, the load should be as large as possible. With plenty of teams and a short haul the loads should be smaller, thus saving the labor of high lifting in loading, and facilitating the work of unloading.

CUTTING THE SILAGE.

A number of satisfactory silage cutters are on the market. The chief features to be considered in a cutter are that it is strongly made and will cut fine. The capacity of the machine to be purchased is important. The mistake is often made of getting one that is too small, thus making the operation of filling the silo very slow and interfering with the continuous employment of the entire force of men. It is better to get a machine so large that every one will

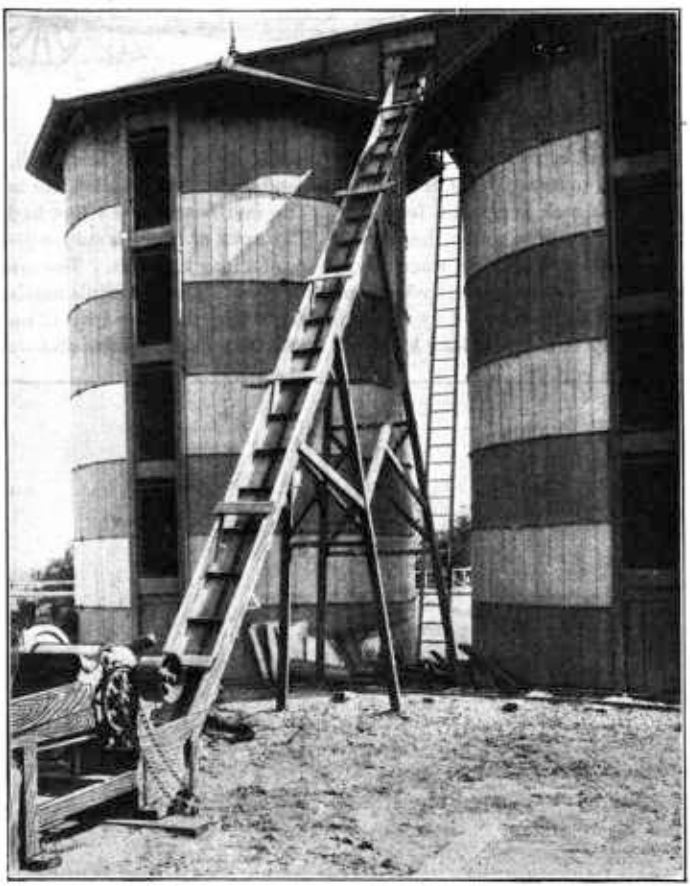

FIG. 6.—Silage cutter with chain carrier.

be able to keep busy all the time. The larger cutters are equipped with self-feeders, a labor-saving device which the smaller sizes lack. Other factors to be taken into account in purchasing a cutter are the amount of work to be done and the power available.

LENGTH TO CUT.

The usual length of cutting varies from one-fourth of an inch to 1 inch. The latter is a little too long, as the pieces do not pack so

closely in the silo and they are not so completely consumed in feeding as the shorter lengths. On the other hand the longer the pieces the more rapidly the corn can be run through the cutter. The bulk of the silage is now cut into pieces less than 1 inch in length. Fine cutting and good tramping are needed if it is desired to make the best quality of silage and fill the silo to its greatest capacity.

ELEVATING THE SILAGE.

Two types of elevators are in use, the old-style chain carrier and the blower (see figs. 6 and 7). The chain carrier requires less power but is harder to set up and makes more litter, especially in windy

FIG. 7.—Silage cutter with blower.

weather. Some chain carriers are so inclosed as to keep the corn from blowing out. In using the blower type the blower should be placed as nearly perpendicular as possible so as to reduce to the minimum the friction of the cut corn upon the inside of the pipe and thus lessen the danger of clogging.

POWER REQUIRED.

The power necessary to operate the cutter depends upon length of knives, sharpness of knives, type of elevator, height of the silo, the rate of feeding, and condition of the corn as regards ears and moisture. Less power is required if the cutter is fed slowly than if fed to full capacity. It is advisable to have sufficient power to run the cutter at full capacity, and many prefer to have a little surplus power. Tables 3 and 4 give the power required for blowers and carriers,

respectively, when gas engines are used. The figures given are thought to represent the minimum power needed to run cutters to full capacity. A smaller engine will necessitate slower feeding, especially with heavy well-eared corn. If power is furnished by a steam engine the horsepower may be reduced 25 per cent, and if by an electric motor the horsepower is reduced 15 per cent. The tables have been prepared from manufacturers' statements, personal observations, and experience, and are not the result of actual experimental tests.

TABLE 3.—*Horsepower (gas engine) required to operate silage cutter and blower, with varying lengths of cutting knives and varying heights of silos.*

Length of knives.	Height of silo—feet.														Approximate capacity.
	24	26	28	30	32	34	36	38	40	42	44	46	48	50	
	Horsepower.														*Tons per hour.*
10	10.5	10.7	10.8	11.0	11.2	11.3	11.4	11.6	11.8	12.0	12.1	12.2	12.4	12.7	4
12	13.1	13.3	13.6	13.8	14.0	14.1	14.4	14.6	14.8	15.1	15.2	15.4	15.6	15.9	5
14	15.8	16.1	16.5	16.8	17.1	17.4	17.7	18.1	18.4	18.7	19.1	19.3	19.6	20.2	7
16	18.5	19.0	19.4	20.0	20.5	21.0	21.5	22.0	22.5	23.0	23.5	24.0	24.5	25.0	9
18	21.6	22.2	22.8	23.4	23.9	24.6	25.1	25.8	26.4	26.9	27.4	28.1	28.6	29.3	11
20	25.6	26.1	26.5	27.0	27.6	28.0	28.4	28.9	29.4	29.8	30.3	30.8	31.4	31.8	13
22	28.6	29.7	30.6	30.8	31.4	31.8	32.4	32.8	33.4	33.9	34.4	34.9	35.3	35.8	15
24	33.1	33.6	34.2	34.8	35.4	36.6	36.0	37.2	37.5	38.0	38.5	39.2	39.8	40.3	17
26	36.6	37.3	38.3	39.0	39.7	40.8	41.6	42.3	43.2	44.1	44.9	45.6	46.5	47.3	19

If a steam engine is used for driving the cutter the above horsepower may be reduced 25 per cent. If an electric motor is used decrease the above horsepower 15 per cent.

TABLE 4.—*Horsepower (gas engine) required to operate silage cutter and chain carrier, with varying lengths of cutting knives and varying heights of silos.*

Length of knives.	Height of silo—feet.														Approximate capacity.
	24	26	28	30	32	34	36	38	40	42	44	46	48	50	
	Horsepower.														*Tons per hour.*
10	2.5	2.6	2.6	2.7	2.9	2.9	2.9	3.0	3.1	3.1	3.1	3.2	3.2	3.3	3
12	4.4	4.5	4.5	4.6	4.7	4.7	4.8	4.8	4.9	4.9	5.1	5.1	5.2	5.2	3
14	6.4	6.5	6.5	6.6	6.7	6.7	6.8	6.8	7.0	7.0	7.1	7.1	7.2	7.2	5
16	8.4	8.5	8.6	8.7	8.9	9.0	9.1	9.2	9.4	9.5	9.6	9.8	9.9	10.0	8
18	10.5	10.7	10.9	11.7	11.1	11.3	11.4	11.6	11.7	11.8	12.0	12.1	12.2	12.4	10
20	13.0	13.1	13.4	13.5	13.6	13.8	13.9	14.1	14.2	14.3	14.4	14.6	14.7	14.9	12

If a steam engine is used for driving the cutter the above horsepower may be reduced 25 per cent. If an electric motor is used decrease the above horsepower 15 per cent.

PACKING THE SILAGE.

Ordinarily the blower or carrier empties the cut corn or other material into the top of the silo, where one or more men distribute and tramp it down. Unless this is done the cut material is thrown too much in one place and the leaves, stalks, and grain are not uniformly distributed. The common practice is to keep the sides slightly higher than the center and to tramp the whole surface thoroughly, especially around the edges. There are some, however, who advocate keeping

the center higher, asserting that when the silo is so filled the silage does not draw away from the edges at the top and admit air. Be this as it may, nothing will take the place of thorough tramping.

Various contrivances have been used for distributing the cut material, the one commonly recommended being a metal pipe similar to the blower pipe, but put together loosely in sections. The cut corn from the blower passes down the pipe into the silo, and the pipe being loosely put together can be swung so as to place the material anywhere in the silo (see fig. 8). With this contrivance it is not necessary to handle the material with a fork; one man can easily do the work of two, very little loose material flies about in the silo, and the work is much cleaner. Another advantage is a lessening of the chance that the man in the silo will be struck by some foreign object which might pass up the blower pipe. As the silage rises in the silo the distributer pipe, which is put together in sections, can be readily shortened as required.

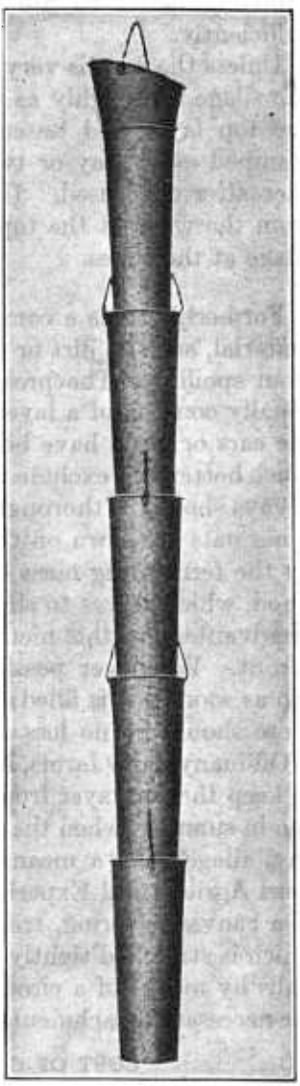

FIG. 8.—Jointed-pipe silage distributer.

A canvas distributer consisting of a tube of canvas fitted over rings can be made with little trouble and at lower cost than the pipe distributer. A distributer of that kind can be rolled up and usually gives good service.

In going into a partially filled silo early in the morning, before the air has had a chance to circulate, there is danger of encountering poisonous gas. To obviate this condition it is a good plan to run the blower a few minutes before entering the silo.

ADDING WATER.

In case the material to be siloed has become too dry, water should be added to supply the deficiency of moisture necessary to make it pack properly. Unless well packed, silage will "firefang" or deteriorate through the growth of mold. Water enough should be added to restore the moisture content of the corn to what it would be if cut at the proper stage.

The water may be applied, by means of a hose and spray nozzle, directly on the silage in the silo as it is filled, or, preferably, it may be run into the blower. In the latter way the water is more evenly mixed with the cut material. When very dry fodder is siloed it is probably better to use both methods in order to wet the fodder sufficiently.

Unless the corn is very green it is a good practice to wet the top of the silage thoroughly as soon as the silo is full. This helps to pack the top layer and lessen the spoilage. The silage should be well tramped every day or two for 10 days after filling and at intervals thereafter until used. Unless this is done the silage will draw away from the walls at the top, admitting air and spoiling several feet of silage at the edges.

COVERING THE SILAGE.

Formerly it was a common practice to cover the silage with some material, such as dirt or cut straw, in order to prevent the top layer from spoiling. The present means of covering, when any is used, usually consists of a layer of cut corn or sorghum stalks from which the ears or grain have been removed. The heavy green stalks pack much better and exclude the air more effectually than straw. The top always should be thoroughly tramped and then wetted down. Sometimes oats are sown on the top before wetting. The heat generated by the fermenting mass causes the oats to sprout quickly and form a sod, which serves to shut off the air from the silage beneath. The disadvantage of this method is that the silage spoils before the oats sprout. Whenever possible it is better to begin feeding from the silo as soon as it is filled; if this is done, no covering is necessary and there should be no loss on account of spoiling.

On many dairy farms, however, the silage is not fed rapidly enough to keep the top layer from spoiling, which is especially liable to happen in summer, when the cows are on pasture and consuming little, if any, silage. As a means of preventing loss of that kind the Missouri Agricultural Experiment Station uses and recommends the use of a canvas covering, treated with hot paraffin to make it air-tight, which is stretched tightly over the silage to within half an inch of the walls by means of a circular iron frame. By means of a pulley and the necessary attachments the canvas can be readily raised or lowered.

COST OF GROWING AND SILOING CORN.

Because of the wide variations in the yields per acre and in the cost of land and labor which are found in the corn-growing sections of the United States, it is not possible to give any figures on the cost of silage which are suitable for general application. Even if these items were uniform the yearly fluctuations in the cost of twine and fuel (gasoline, kerosene, coal, or wood) and other incidentals are such as to make it impossible to forecast the exact cost of silage in

any particular instance. If, however, the various items of expense on one farm are enumerated it should be possible to determine approximately the cost of silage on other farms even though some of the conditions vary widely.

Tables 5 and 6 were compiled from data kept at the Dairy Division Farm, Beltsville, Md., where detailed records are kept on the cost of all farm operations. They are not given as representative of the exact cost of silage in other sections or even on other farms in the locality. The data apply to the complete cost of growing and siloing 65.76 acres of corn, yielding by actual weight at time of siloing 670.46 tons of silage, or an average of 10.19 tons an acre. Of the 65.76 acres, 29.3 were grown in 1915 and cut with a corn harvester. The corn on the remaining 36.46 acres, grown in 1916, was so badly lodged that it was necessary to cut it by hand. A 15–30 horsepower kerosene tractor was used to run the cutter, and was also used to plow a part of the land preparatory to planting the corn.

Land was arbitrarily valued at $100 an acre. All other items included in the tables are taken directly from the farm records. Board and room were not furnished to employees. The only known factors not considered were taxes, insurance, and the manager's time.

TABLE 5.—*Cost of growing 65.76 acres of corn for silage.*

Man hours, 2,377.4, at 18.39 cents	$437.32
Mule hours, 2,385.7, at 8.4 cents	200.38
Interest on tractor, 65.8 hours, at 20 cents	13.16
Depreciation on tractor, 65.8 hours, at $1	65.80
Supplies for tractor	25.83
Interest on land, $100 an acre, at 5 per cent	328.81
Commercial fertilizer and limestone, 91.79 tons	688.68
Barnyard manure, 280.03 tons, at $3 (one-half value first year)	420.05
Seed corn, 13.15 bushels, at $2.444	32.16
	2,212.19
Cost per acre	33.64
Cost per ton	3.30

TABLE 6.—*Cost of harvesting and siloing 65.76 acres of corn.*

Man hours, 2,653.5, at 19.34 cents an hour	$513.32
Mule hours, 1,249, at 8.4 cents an hour	104.90
Binder twine, 145.3 pounds, at 11¾ cents a pound	17.07
Tractor supplies, gasoline, and oil	70.06
Interest on tractor, 202 hours, at 20 cents	40.40
Depreciation on tractor, 202 hours, at 50 cents	101.00
Interest on corn harvester, 54.6 hours, at 4.2 cents	2.29
Depreciation on corn harvester, 54.6 hours, at 20.8 cents	11.36
Interest on cutter, 202 hours, at 8 cents	16.16
Depreciation on cutter, 202 hours, at 40 cents	80.80
Interest on 3 wagons, 3 racks, 3 sets double harness	1.13
Depreciation on 3 wagons, 3 racks, 3 sets double harness	4.66
	963.15
Cost per acre	14.65
Cost per ton	1.44

Investigations of 21 farms in the State of New York, reported in Bulletin 377 of the Cornell Agricultural Experiment Station, showed that the interest and depreciation charges on silos amounted to 24 cents a ton annually, which, added to $1.44, makes a cost of $1.68 for harvesting, siloing, and storing. This, added to the $3.30 for growing, gives a total cost of $4.98 a ton for silage when stored in the silo

The use of both barnyard manure and commercial fertilizer for growing a crop of corn may be regarded as an exception to the general practice among farmers. As shown in Table 5, $688.63 was expended for fertilizer, and the cost of applying it was $107.62. While the latter expense is not mentioned as a separate item in Table 5, it is included in the charges for man and mule labor. Accordingly, the total cost of the fertilizer was $796.30. Had it been possible to obtain the same yields per acre and to maintain the fertility of the soil without the commercial fertilizer, the cost of the silage would have been reduced to $3.79 a ton.

Some varieties of corn, of which the Eureka is an example, have a high percentage of stalks and leaves and usually yield more per acre, and in consequence lower the cost of silage per ton. As a rule, however, such varieties produce a poorer quality of silage. Then again the tons per acre vary with the stage of maturity. It is evident, therefore, that any figures on either the cost or the feeding value of silage should take into account the kind of corn grown and its condition at the time of harvesting.

FEEDING VALUE OF SILAGE.

COMPOSITION.

The chemical composition and the nutritive value of silage vary according to the crop from which it is made, the degree of maturity of the crop, and other factors. The figures in Table 7 show the average quantity of digestible nutrients in 100 pounds of silage and other succulent feeds.

TABLE 7.—*Average digestible nutrients and net energy value per 100 pounds of silage and other succulent feeds.*

[From "Feeds and Feeding," by Henry and Morrison.]

Crop.	Total dry matter.	Digestible dry matter.			True protein.	Net energy value.
		Crude protein.	Carbohydrates.	Fat.		
	Pounds.	*Pounds.*	*Pounds.*	*Pounds.*	*Pounds.*	*Therms.*
Green-corn fodder	21.9	1.0	12.8	0.4	0.8	14.06
Corn silage	26.3	1.1	15.0	.7	.6	15.90
Green-sorghum fodder	24.9	.7	14.1	.6	.4	15.37
Sorghum silage	22.8	.6	11.6	.5	.....	.....
Uncured red clover	26.2	2.7	13.0	.6	1.7	15.87
Clover silage	27.8	1.3	9.5	.5	.8	7.26
Uncured soy bean	23.6	3.2	10.2	.5	2.4	12.53
Soy-bean silage	27.1	2.6	11.0	.7	1.5	11.59
Uncured cowpeas	16.3	2.3	8.0	.3	1.7	10.42
Cowpea silage	22.0	1.8	10.1	.6	1.1	11.05
Uncured oats and peas	22.6	2.4	10.6	.6	.....	.....
Mangels	9.4	.8	6.4	.1	.1	5.68
Sugar beets	16.4	1.2	12.6	.1	.4	11.20
Sugar-beet pulp (wet)	10.0	.8	6.5	.3	.5	9.32
Prickly pear	16.5	.4	8.9	.2	.....	.....

PALATABILITY.

No rough feed is more palatable than good corn silage. Sometimes, however, a dairy cow will not eat silage readily until she has acquired a taste for it, which may require several days. Silage is not peculiar in this respect, however, for it has been observed that range horses and cattle shipped into the Corn Belt refuse corn the first time it is offered to them. Palatability is of great importance, as it induces a large consumption and stimulates the secretion of digestive juices.

SILAGE FOR DAIRY CATTLE.

T. E. WOODWARD and J. B. MCNULTY, *of the Dairy Division.*

Silage has been found to be particularly well adapted as a feed for dairy cows, and in consequence silos are more numerous upon farms devoted to dairying than upon farms of any other kind. In many sections silage has come to be the dairy farmer's main reliance for cow feed in winter.

SUPPLEMENTARY FEEDS.

While silage is an excellent feed, it is not a complete one for dairy stock. It is too bulky and watery and contains too little protein and mineral matter to meet fully the requirements of the dairy cow. It should be combined with some leguminous hay, such as clover, cowpea, or alfalfa. These will tend to correct the deficiencies of the silage in dry matter, protein, and mineral constituents. However, a ration, of silage and legume hay without grain is satisfactory only for cows which are dry or which give but a small quantity of milk. Cows in full milk require some concentrated feed in addition to hay and silage, as they can not consume enough of these feeds to keep up a large flow of milk and maintain body weight.

QUANTITY TO FEED.

The quantity of silage to feed a cow depends upon the capacity of the animal to consume feed. She should be fed as much as she will clean up without waste when consumed with hay and grain. Increase or lessen until the proper quantity is ascertained, bearing in mind that in general a good cow should be fed just short of the limit of her appetite. If she refuses any of her feed it should be reduced at once. The smaller dairy cows eat from 20 to 30 pounds a day and the larger as much as 40 or more.

RATIONS.

In general, dairy cows should be supplied with all the roughage they will clean up, with grain in proportion to the milk or butterfat produced. The hay needed ordinarily ranges between 5 and 12 pounds per cow per day, or 0.8 pound per hundred pounds of live weight when fed in connection with silage. Silage should be fed in

the proportion of about 2.5 to 3.0 pounds per 100 pounds of live weight. For Holsteins 1 pound of concentrates for each 4 pounds of milk produced in addition to roughage will prove to be about right. For Jerseys 1 pound for each 2½ to 3 pounds of milk will come nearer to meeting the requirements. The grain for other breeds varies between these two according to the quality of milk produced. A good rule is to feed as many pounds of grain daily as there are pounds of butterfat produced weekly. With good silage and plenty of first-class legume hay little grain is needed for cows of ordinary production. Alfalfa especially, if fed liberally, will enable the feeder to reduce the grain allowance to the minimum.

TIME TO FEED.

The time to feed silage is directly after milking. If this is impossible, it may be fed several hours before milking. In such cases there is a chance that the silage odor may taint the milk. On the other hand, if feeding is done after milking the odors from the silage will have disappeared before the next milking hour. Silage is usually fed twice, although sometimes three times a day.

FEEDING FROZEN SILAGE.

Frozen silage must be thawed before using, after which it should be fed immediately, that is, before decomposition sets in. No harm will result from feeding silage handled in this manner, nor is the nutritive value known to be changed in any way.

SILAGE FOR CALVES, BULLS, AND DRY COWS.

Calves may be given silage when only a few weeks old. In this case, however, it is of greater importance that the silage be free from mold or decay than when fed to mature stock. At all times calves may have all the good silage they will eat up clean. Yearling calves consume more than one-half as much as mature stock, that is, 20 or more pounds a day if they are well grown. When supplemented with some good leguminous hay little grain is required to keep the yearlings in a thrifty, growing condition.

An opinion is held by some breeders of dairy stock that a large allowance of silage is detrimental to the breeding qualities of the bull. Whether there is any scientific foundation for this opinion remains to be determined. Probably it is a good plan to limit the allowance to about 12 pounds of silage a day for each 1,000 pounds of live weight. When fed in this quantity silage is thought to be a good, cheap, and safe feed for bulls. It should be supplemented with hay, of course, and with grain also, especially in the case of bulls doing active service or growing rapidly.

Cows when dry consume almost as much roughage as when they are at the pail. Silage may well form the principal ingredient of their

ration; in fact, with from 25 to 40 pounds of silage and a small supplementary feed of clover, cowpea, or alfalfa hay—from 5 to 8 pounds a day—the cows will keep in good flesh and even gain in weight. Dry cows in thin flesh should always receive a small quantity of grain. Silage tends to keep the whole system of the cow in good condition and in this way lessens the difficulties of calving.

SILAGE FOR SUMMER FEEDING.

One of the most trying seasons of the year for dairy cows is the latter part of summer and early in the fall. At this season the pastures are often short or dried up, and it is a common mistake of dairymen to let their cows decrease in milk flow because of the shortage of feed at that time. Later in the fall it is impossible to restore the milk flow, no matter how well the cows are fed. On good dairy farms the milk flow of the cows is maintained at as high a level as possible, from parturition to drying off. It becomes necessary, therefore, to supply some feed in addition to pasture grass. The easiest way to do this is to feed silage, which is cheaper and decidedly more convenient to use than soiling crops. The quantities to feed depend upon the condition of the pastures, varying all the way from 10 pounds to a full winter feed.

SILAGE FOR HORSES.

GEORGE M. ROMMEL, *Chief of the Animal Husbandry Division.*

Silage has not been fed generally to horses, partly because of a certain degree of danger in its use, but still more, perhaps, on account of prejudice. In many cases horses have been killed by eating moldy silage, and the careless person who fed it at once blamed the silage rather than his own carelessness and the mold, which really was the cause of the trouble. Horses are peculiarly susceptible to the effects of molds, and under certain conditions varieties of mold which are deadly poisons to both horses and mules are found on silage. Molds must have air to grow and therefore silage which is packed air-tight and fed out rapidly will not become moldy. If the feeder watches the silage carefully as the weather becomes warmer, he can soon detect the presence of mold. When mold appears he should immediately stop feeding the silage to horses or mules.

It is also unsafe to feed horses frozen silage because of the danger of colic. It is practically impossible to avoid frozen silage in very cold weather, especially in solid-wall silos. By taking the day's feed from the unfrozen center of the silo and chopping away the frozen silage from the edges and piling the frozen pieces in the center the mass will usually thaw out in time for the next feed.

Corn to be made into silage for horses should not be cut too green, as sour silage will result and may cause colic when fed. The corn should be well matured and cut when the grain is beginning to glaze. The silo should be filled rapidly and the corn should be carefully tramped and packed while filling. This is by far the most important point in connection with feeding silage to horses, and the lives of the horses fed on silage may depend on the thoroughness with which the tramping is done. If properly done no danger is liable to result; if not properly done air pockets may form and cause the accumulation of a small mass of mold which the feeder may overlook but which may be sufficient to kill one or more horses.

The value of silage for horses is greatest as a means to carry them through the winter cheaply or to supplement pasture during drought. As the danger of mold is greater in summer than in winter, silage should not be fed to horses in that season unless a large number of animals are getting it and the daily consumption is so large as to preclude the formation of mold on the surface.

Good corn silage is a splendid feed for cheapening the ration for idle horses in winter. If the grain goes into the silo with the stover no additional grain is needed for them, hay being the only supplementary feed necessary. If there is little grain on the corn the silage should be supplemented with 1 pound of old-process linseed-oil meal or cottonseed meal daily per 1,000 pounds live weight, sprinkled over the silage.

Horses to be wintered on a silage and hay ration should be started on about 5 pounds of silage daily per 1,000 pounds live weight, the grain and hay ration being gradually decreased as the silage is increased until the ration is 20 pounds of silage and 10 pounds of hay daily per 1,000 pounds live weight. It will require about a month to reach the full feed of silage, but the period may be decreased somewhat, depending on the judgment and skill of the feeder.

Work horses when idle can be wintered satisfactorily in this manner, but much silage is not recommended for horses at heavy work for the same reason that a driving horse can not do his best while on watery grass pasture.

The writer knows of cases in which stallions receive rations of silage, but has had no experience in feeding them in this manner. There seems to be no reason why silage should not be a valuable feed for stallions during the idle season.

Silage should be useful also for young horses, especially drafters, but here again the writer can not quote his own experience, and experimental data are meager.

To summarize, silage is safe to feed to horses and mules only when it is made from fairly mature corn properly stored in the silo. When it is properly stored and is not allowed to mold, no feed excels it as

a cheap winter ration. With plenty of grain on the cornstalk horses have been kept in good condition on a ration of 20 pounds of silage and 10 pounds of hay for each 1,000 pounds of live weight.

SILAGE FOR BEEF CATTLE.

E. W. SHEETS, *of the Animal Husbandry Division.*

There is no roughage which occupies a place of more importance in the economical feeding of beef cattle than silage. The increased value of all roughages as well as of grain has correspondingly increased the value of silage in its various forms for beef production. While silage is not a cheap feed it is in most cases a great saver of grain as well as other feeds whether fed to breeding stock, growing animals, or fattening cattle.

SILAGE FOR THE BREEDING HERD.

Silage, when available, should form the principal part of the winter ration for the breeding herd. Cows and calves relish it and thrive upon it when some supplement is added. Silage in the ration creates an appetite for less palatable and cheaper roughages, thus reducing the cost of wintering. Good legume hays as a rule should be fed to the cows suckling calves unless a protein concentrate, such as cottonseed meal or oil meal, is fed with the other roughages. It may also be advisable to feed 2 or 3 pounds of grain in addition, especially if the cows are milking heavily and are somewhat thin in flesh.

The following rations are well adapted to wintering 1,000-pound cows under average conditions and should more than maintain their weight.

TABLE 8.—*Suggested rations for wintering beef cows.*

Feeds fed.	Average daily amount of feed.			
	Ration 1.	Ration 2.	Ration 3.	Ration 4.
	Pounds.	*Pounds.*	*Pounds.*	*Pounds.*
Silage (corn or sorghum)	25 to 30	25 to 30	25 to 30	35 to 40
Legume hay (clover, alfalfa, etc)	6 to 8	.....	.....	.....
Nonlegume hay (grass hays, also stover)	.....	6 to 8	.....	.....
Cereal straw (oat, wheat, rye, etc.)	2 to 4	2 to 4	8 to 10	.....
Protein concentrate (oil meal, cottonseed meal, etc.)	.....	½ to 1	1 to 2	1½ to 2½

For dry cows, silage and cheap roughages, such as coarse hays and stover, may be used almost exclusively, thus greatly reducing the cost of wintering. The amount or even the kinds of roughages and other feed in addition to silage will be largely determined by the quality of the silage. If there is little mature corn in the silage or if the mature corn was removed before filling the silo, it is necessary to give more silage or to supplement it with other or more nutritious feeds.

Generally good results are obtained in feeding breeding bulls one-half as much silage per head as is given to cows. As in the ration for breeding cows a small amount of grain should be supplied in addition to the amount of silage used, depending upon the condition of the animal, the exercise or service given, and the nature of other roughages fed.

SILAGE FOR GROWING CALVES.

Before they are weaned calves should be fed silage only in limited quantities. Silage is especially relished by calves just weaned. They take to it more quickly than to dry feed and lose but little weight during the weaning period when they are liberally fed on grain, legume hay, and silage. After they are weaned the amount of silage as well as other feeds should be determined by the use to be made of the calf. If kept for breeding purposes or for finishing at an early age, they should have a more liberal allowance of grain and legume hay. A calf will eat the coarser, cheaper roughages but as a rule will give greater returns than older cattle from the use of better feeds and dry roughages, such as clover, alfalfa, and lespedeza.

A small quantity of grain should also be given for best results, together with a very little oil meal, peanut meal, or cottonseed meal.

The following rations will keep calves weighing from 400 to 600 pounds growing in a thrifty condition and allow considerable gain during the winter:

TABLE 9.—*Suggested rations for wintering beef calves.*

Feeds fed.	Average daily amount of feed.			
	Ration 1.	Ration 2.	Ration 3.	Ration 4.
	Pounds.	*Pounds.*	*Pounds.*	*Pounds.*
Silage (corn or sorghum)	15 to 20	15 to 20	15 to 20	20 to 25
Legume hay (clover, alfalfa, etc.)	2 to 5	.....	.....	.....
Nonlegume hay (grass hays, also stover)	.....	4 to 6	.....	.....
Cereal straw (oat, wheat, etc.)	.....	.....	4 to 6	.....
Protein concentrates (oil meal, cottonseed meal, etc.)	.....	¼ to ½	½ to 1	¾ to 1½

SILAGE FOR WINTERING STOCKERS.

The ration for wintering stockers or feeders depends largely upon the feeds available. While silage is undoubtedly one of the best feeds for wintering stockers of all ages, nevertheless one must keep in mind the fact that they make better use of the dry, coarse, cheap roughages produced on the farm than do breeding cows or growing calves. For that reason it is frequently advisable to limit the silage fed to the stockers and give them more of the less desirable feeds. Many, however, withhold silage altogether, which is a great mistake. If it should be found desirable to remove the more mature ears from the corn before filling the silo, stockers will utilize such silage to better

advantage than other cattle except possibly dry cows. When such silage is used it should be fed more liberally than where no ears have been removed.

In the grazing areas the cost of the winter rations has been found to be approximately two-thirds the feed cost for the year. It is desirable that stockers make some gain during the winter if they are to make the maximum gain for the year. From the standpoint of economy in the ration, silage can hardly be replaced by any other feed for this purpose.

If hay or other dry roughages are scarce and high in price and grain comparatively cheap, it may be advisable to limit the dry roughage to a few pounds and greatly increase the amount of silage, supplying in addition a protein concentrate, such as cottonseed meal, oil meal, or velvet beans. The following rations will usually be found satisfactory for wintering stockers or feeders weighing from 600 to 800 pounds, and should more than maintain the weight of the animals.

TABLE 10.—*Suggested rations for wintering yearling stockers and feeders.*

Feeds fed.	Average daily amount of feed.			
	Ration 1.	Ration 2.	Ration 3.	Ration 4.
	Pounds.	*Pounds.*	*Pounds.*	*Pounds.*
Silage (corn or sorghum)	20 to 25	20 to 25	20 to 25	25 to 35
Legume hay (clover, alfalfa, etc.)	3 to 4	.....	.....	.....
Nonlegume hay (grass hays, also stover)	.....	3 to 4	.....	.....
Cereal straw (oat, wheat, etc.)	2 to 4	2 to 4	6 to 8	.....
Protein concentrate (cottonseed meal, oil meal, etc.)	.....	½ to 1	½ to 1	1 to 2

The rations suggested for yearlings are especially adapted for feeding older cattle. The amount of silage should be increased 5 to 10 pounds for 2-year-old cattle and 10 to 15 pounds for older cattle, depending upon their size and condition as well as the quality of silage fed. The dry roughages should also be increased accordingly from 3 to 5 pounds for each year of increase in age or proportionate size.

SILAGE FOR FATTENING CATTLE.

The feeding of silage came into use with the advent of high-priced grain and has become more popular each year. With the price of grain as well as roughages remaining as it has been for several years there are few rations that can not be very greatly cheapened and benefited by the addition of silage in liberal amounts in some form or other, especially at the beginning of the feeding period.

Results of recent experimental work indicate that steers can be brought to a satisfactory finish on a ration which includes but little grain, except that which is fed in the silage. In such cases the silage should provide the basis of the ration, the steers being allowed as

much as they will eat, supplemented by cottonseed meal or oil meal with alfalfa or clover hay in addition. The rate of daily gain and the degree of finish attained by steers fed in this manner have been found to be only slightly below the gain and finish made by steers fed rations containing considerably more grain. It is at once evident, however, that the silage used must be of good quality and no mature ears whatever removed in order to insure the most satisfactory results. This ration probably will become extensively used in time, as it is more than likely that the bulk of the beef of the future will be eaten with less fat than formerly.

For 1,000-pound fattening animals the following average rations should be found satisfactory:

TABLE 11.—*Suggested rations for fattening cattle.*

Feeds fed.	Average daily amount of feed.[1]				
	Ration 1.	Ration 2.	Ration 3.	Ration 4.	Ration 5.
	Pounds.	*Pounds.*	*Pounds.*	*Pounds.*	*Pounds.*
Silage (corn or sorghum)	25 to 30	25 to 30	30 to 35	30 to 35	45 to 50
Legume hay (clover, alfalfa, etc.)	1 to 2	6 to 8	.....	.....	1½ to 2
Nonlegume hay (grass, hay, also stover)	.....	.....	4 to 6	6 to 8	.....
Protein concentrate,[2] cottonseed meal, oil meal, etc.	2 to 3	.....	3 to 4	4 to 6	2½ to 3
Corn (shelled or broken ear)	12 to 14	14 to 15	8 to 10	.....	.....

[1] The amount of the different feeds given is the average to be fed during the entire feeding period. It will be necessary to use smaller amounts at the beginning and increase the feeds gradually until the cattle are on full feed. As feeding progresses the silage and other roughages are gradually reduced and the concentrates increased.

[2] Where velvet beans (in pods) are used, 2½ pounds will be found aproximately equivalent to 1 pound of cottonseed meal.

It should be understood that the rations given are not necessarily to be fed in the exact amounts given but should be modified to suit local conditions and the feeds available on each farm as well as the prices of the different feeds. It may be found desirable in many sections of the South to substitute cottonseed hulls for nonlegume hays or even for legume hay when the price for the hulls would make such a purchase advisable.

SILAGE FOR SHEEP.

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The use of silage in the winter ration of the flock is increasing. Heretofore many sheepmen have been prejudiced against the use of silage, claiming that it caused abortion and losses of breeding stock. These beliefs are unfounded, and it has been proved by different experiment stations in tests with both breeding and feeder lambs that silage is an economical as well as valuable part of the ration. Where moldy, decomposed, or too acid silage is fed losses occur, but judicious feeding of silage improves the health and vitality of the flock.

SILAGE FOR THE BREEDING FLOCK.

No cheaper or better roughage can be fed the breeding flock than good corn silage, which furnishes the succulence so necessary for the maintenance of the health and vitality of the ewes.

A good quality of silage is very palatable, and quantities ranging from 1 to 5 pounds per head per day have been fed in different feeding trials with good results. The quantity to be fed depends on the class of sheep and the character of the other feeds comprising the ration. As a rule, however, not more than 4 pounds of silage per head per day should be fed, and some hay always should be retained in the ration.

Silage shows the best results when fed with a good legume hay. A satisfactory ration for a breeding ewe would consist of the following:

	Pounds.
Corn silage	3 to 4
Clover or alfalfa hay	2 to 3

Toward the end of the period of pregnancy it would be well to add about one-half to 1 pound of grain to the ewe's ration, thus insuring a strong lamb. If the silage contains a fairly large quantity of grain, however, this increase may not be necessary. If the ewes are in extra good condition at the beginning of winter and do not lamb until the pasture season opens, grain may be dispensed with. Usually earlier lambing and the use of some grain are found to be more profitable.

SILAGE FOR LAMBS.

In fattening lambs corn silage not only saves hay and grain, but reduces the cost of gains.

Care must be exercised in starting lambs on silage. If too much is given at the beginning of the feeding period, the lambs will probably go off feed and scour. To prevent this offer a small quantity at the start and gradually increase the daily allowance until they are on full feed. Lambs weighing from 50 to 60 pounds should consume

about 1.5 pounds of silage per head per day when receiving grain, and hay in addition. Larger quantities of silage can be fed, but some protein supplement, such as linseed or cottonseed cake, should be added to balance the ration.

A fattening ration for lambs that gave excellent results at the Indiana experiment station is as follows:

	Pounds.
Grain (shelled corn, 4 parts, cottonseed meal, 1 part)	1.1
Corn silage	1.38
Clover hay	1.12

In wintering ewe lambs silage should form an important part of the ration, and when fed in conjunction with a good legume hay it not only keeps the lambs in good condition but furnishes a good growing ration.